



Complete Summary

GUIDELINE TITLE

Best evidence statement (BESt). Blood pressure measurement in children.

BIBLIOGRAPHIC SOURCE(S)

Cincinnati Children's Hospital Medical Center. Best evidence statement (BESt). Blood pressure measurement in children. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2009 Jan 9. 9 p. [27 references]

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE
METHODOLOGY - including Rating Scheme and Cost Analysis
RECOMMENDATIONS
EVIDENCE SUPPORTING THE RECOMMENDATIONS
BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS
QUALIFYING STATEMENTS
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CATEGORIES
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SCOPE

DISEASE/CONDITION(S)

Prehypertension and hypertension

GUIDELINE CATEGORY

Diagnosis
Evaluation
Screening

CLINICAL SPECIALTY

Cardiology
Family Practice
Pediatrics

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Health Care Providers
Nurses
Patients
Physician Assistants
Physicians

GUIDELINE OBJECTIVE(S)

To provide best evidence statements for the measurement of blood pressure in children

TARGET POPULATION

Pediatric patients (ages 0 to 18 years)

INTERVENTIONS AND PRACTICES CONSIDERED

1. Blood pressure measurement (method and frequency)
2. Oscillometric device for routine surveillance
3. Auscultation with mercury or aneroid sphygmomanometer for diagnostic evaluation of elevated blood pressure
4. Automated devices for neonates and young infants
5. Positioning of patient and timing
6. Confirmation of hypertension
7. Referral to primary care provider or specialist, as necessary

MAJOR OUTCOMES CONSIDERED

- Percent of patients having blood pressure evaluated at current visit
- Percent of patients having blood pressure measurements documented in structured data fields (completeness)
- Proportion of population accurately diagnosed as hypertensive
- Proportion of population accurately diagnosed as pre-hypertensive
- Percent of at-risk patients whose elevated blood pressure is confirmed by using the gold standard measurement process (all or none composite)

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Original Search

- OVID Databases
 - Medline, CINAHL and the Cochrane Database for Systematic Reviews (CDSR)
- OVID Filters
- Publication Date: 2003 to present
 - Limits: Humans and English Language
 - "All child (0 to 18 years)"
- Journal Filter: General interest medical journals: British
 - Medical Journal, JAMA, Lancet, New England Journal of Medicine
- General interest pediatric journals: Archives of Diseases in Childhood & Fetal & Neonatal Edition, Archives of Pediatric and Adolescent Medicine, Journal of Pediatrics, Pediatrics
- Topic-specific specialty journals: American Heart Journal, American Journal of Cardiology, American Journal of Hypertension, Blood Pressure Monitoring, Hypertension, Journal of Human Hypertension, Journal of Hypertension, Pediatric Nephrology

Search Terms and MeSH Terms:

- Patients/Population
 - Pediatric patients, pediatrics
 - Ambulatory patients/outpatients
- Intervention/Exposure
 - Blood Pressure/ph [Physiology]
 - Blood Pressure Determination/ct [Contraindications]
 - Blood Pressure Determination/is [Instrumentation]
 - Blood Pressure Determination/mt [Methods]
 - Blood Pressure Determination/st [Standards]
 - Blood Pressure Determination/sn [Statistics & Numerical Data]
 - Diagnostic Errors/in [Instrumentation]
 - Diagnostic Errors/sn [Statistics & Numerical Data]
 - Predictive Value of Tests – additional limits Diagnosis/specificity, Diagnosis/sensitivity
 - Casual blood pressure measurements.mp
 - Outcomes Accurate blood pressure measurement

Additional Articles:

- Identified from reference lists and clinicians

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Levels of Evidence

Quality Level	Definition
1a* or 1b*	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5	Other: General review, expert opinion, case report, consensus report, or guideline

*a = good quality study; b = lesser quality study.

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

In determining the strength of a recommendation, the development group makes a considered judgment in a consensus process that incorporates critically appraised evidence, clinical experience, and other dimensions as listed below:

1. Grade of the Body of Evidence (see the "Rating Scheme for the Strength of the Evidence" field)
2. Safety/Harm
3. Health benefit to patient (direct benefit)
4. Burden to patient of adherence to recommendation (cost, hassle, discomfort, pain, motivation, ability to adhere, time)
5. Cost-effectiveness to healthcare system (balance of cost/savings of resources, staff time, and supplies based on published studies or onsite analysis)
6. Directness (the extent to which the body of evidence directly answers the clinical question [population/problem, intervention, comparison, outcome])
7. Impact on morbidity/mortality or quality of life

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Strength of Recommendation

Strength	Definition
"Strongly recommended"	There is consensus that benefits clearly outweigh risks and burdens (or visa-versa for negative recommendations).
"Recommended"	There is consensus that benefits are closely balanced with risks and burdens.
No recommendation made	There is lack of consensus to direct development of a recommendation.

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Not stated

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Definitions for the strength of the recommendation ("strongly recommended", "recommended", and no recommendation made) and levels of evidence (1a-5) are provided at the end of the "Major Recommendations" field.

Patients

1. It is recommended that children over the age of 3 years have their blood pressure measured at least once a year as part of routine preventive health screening (American Academy of Pediatrics [AAP] Committee on Practice and Ambulatory Medicine and Bright Futures Steering Committee, 2007 [5]; Local Consensus [5]).

Note: Data from the 2006 National Ambulatory Medical Care Summary indicates that blood pressure was recorded at 25.8% (SE 1.6) of visits by children (0-17 years of age) (Cherry et al., 2008 [4a]).

2. It is recommended that all children with any chronic medical condition(s) and/or being treated with medications known to raise blood pressure have

their blood pressure measured at least once during every health care encounter (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]; Local Consensus [5]).

Method

3. It is recommended that auscultation with mercury or aneroid sphygmomanometer be used for diagnostic evaluation of blood pressure elevation (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]; Local Consensus [5]).

Note 1: Blood pressure measurement with an oscillometric device may be acceptable for routine surveillance (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]; Jones et al., 2003 [5]; Local Consensus [5]). An elevated blood pressure reading obtained with an oscillometric device should be repeated using the auscultatory method (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]).

Note 2: Use of automated devices may be necessary for blood pressure measurement in newborns and young infants, in whom auscultation may be difficult (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]; Local Consensus [5]).

4. It is recommended that the following procedure for blood pressure measurement be followed, regardless of the type of device used. (Pickering et al., 2005 [5]; National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]; Chobanian et al., 2003 [5b]).
 - a. Correct position: child is sitting, with legs uncrossed with cuff at heart level. Infants and small children may be lying down.

Note: Blood pressure measurements may be elevated when the patient is lying down (Eser et al., 2007 [4b]; Netea et al., 2003 [4b]). When patients are lying down, the arm used for blood pressure measurement is supported at the level of the right atrium to avoid falsely elevated blood pressure measurements (Netea et al., 2003 [4b]).

- b. Rest period before measurement: at least 5 minutes of rest in sitting position before blood pressure measurement.
 - c. Correct size blood pressure cuff: use an appropriate cuff size based on arm circumference.

Note 1: The width of the cuff's inflatable bladder is at least 40% of arm circumference. The inflatable bladder length should cover 80-100% of the circumference of the arm (Pickering et al., 2005 [5];

National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]).

Note 2: Refer to manufacturer's marks on the cuff to determine the correct cuff size or measure the arm circumference at the midpoint between the olecranon and the acromion.

Note 3: If a cuff is too small, the next largest cuff should be used, even if it appears large.

- d. Average of two measurements: to best characterize blood pressure values, obtain an average of 2 or more values. If blood pressure is elevated, wait at least 30 seconds and repeat the measurement. Reported blood pressure for the visit is the average of the two sets of values.

Confirmation of Elevated Blood Pressure

5. It is recommended that the following guidelines be used to diagnose elevated blood pressure, based on the current gender-, age-, and height-appropriate blood pressure tables (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]).
 - a. Systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) (i.e., average of two measurements as per 4d. above) less than the 90th percentile is normal.
 - b. Systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) (i.e., average of two measurements as per 4d. above) between the 90th and 95th percentile or BP equal to or exceeding 120/80 at any age is prehypertension (see Table below) (Local Consensus [5]).
 - c. Systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) (i.e., average of two measurements as per 4d. above) greater than 95th percentile on ≥ 3 occasions is hypertension.
6. It is recommended that elevated blood pressure measurements be confirmed on repeated visits before characterizing a child as having prehypertension or hypertension (See Table below) (Pickering et al., 2005 [5]; National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]; Local Consensus [5]).

Note 1: Incorrect technique may result in inaccurate blood pressure measurements (Eser et al., 2007 [4b]; Prineas et al., 2007 [4b]; Sala et al., 2005 [4b]; Mourad et al., 2003 [4b]; Netea et al., 2003 [4b]; National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]; Jones et al., 2003 [5]; Local Consensus [5]) – See Blood Pressure Assessment Algorithm on page 7 in the original guideline document.

Note 2: Blood pressure at high levels tends to fall on subsequent measurements as the result of (1) an accommodation effect (i.e., reduction of anxiety by the patient from one visit to the next), and (2) regression to the mean (Chiolerio et al., 2007 [4a]; National High Blood Pressure Education

Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]).

Note 3: Recommended frequency of measurement varies with blood pressure level (see Table below).

Table: Classification of Hypertension in Children and Adults with Measurement Frequency

Â	SBP* or DBP** Percentile	Frequency of BP Measurement
Normal	<90 th percentile	Recheck at next scheduled physical examination.
Prehypertension	90 th to <95 th percentiles or ≥120/80 at any age	Recheck in 6 months.
Stage 1 hypertension	>95 th and <99 th percentile plus 5 mm Hg	Recheck in 1-2 weeks or sooner if patient is symptomatic. If persistently elevated on 2 additional occasions, evaluate or refer to hypertension specialist within 1 month.
Stage 2 hypertension	>99 th percentile plus 5 mm Hg	Evaluate or refer to pediatric hypertension specialist (e.g., pediatric nephrology or pediatric cardiology) within 1 week or immediately if symptomatic.

*Systolic blood pressure. Â **Diastolic blood pressure. Source: (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004 [5]).

8. It is recommended that children and adolescents be referred according to their blood pressure values (See Appendix in the original guideline document):
 - a. Children and adolescents whose blood pressure is ≥90th percentile but <99th percentile plus 5 mm Hg can be referred to primary care provider for confirmation or consider referring to a pediatric hypertension specialist (e.g., pediatric nephrology or pediatric cardiology) (Local Consensus [5]).
 - b. If a patient's blood pressure is >99th percentile plus 5 mm Hg, the patient should be referred to a pediatric hypertension specialist (i.e., pediatric nephrology or pediatric cardiology) for prompt evaluation and treatment (Local Consensus [5]).

Definitions:

Strength of Recommendations

Strength

Definition

Strength	Definition
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"Recommended"	There is consensus that benefits are closely balanced with risks and burdens.
No recommendation made	There is lack of consensus to direct development of a recommendation.

Levels of Evidence

Quality Level	Definition
1a* or 1b*	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5	Other: General review, expert opinion, case report, consensus report, or guideline

*a = good quality study; b = lesser quality study.

CLINICAL ALGORITHM(S)

The original guideline document contains a clinical algorithm for Blood Pressure Assessment.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

REFERENCES SUPPORTING THE RECOMMENDATIONS

[References open in a new window](#)

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is specifically stated for each recommendation (see the "Major Recommendations" field).

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Routine blood pressure measurements can provide early recognition of both prehypertension and hypertension in children and adolescents, reducing present and future health risks, including target-organ abnormalities and the risk of cardiovascular disease.

POTENTIAL HARMS

Not stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Clinical Algorithm

For information about [availability](#), see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Staying Healthy

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Cincinnati Children's Hospital Medical Center. Best evidence statement (BEST). Blood pressure measurement in children. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2009 Jan 9. 9 p. [27 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2009 Jan 9

GUIDELINE DEVELOPER(S)

Cincinnati Children's Hospital Medical Center - Hospital/Medical Center

SOURCE(S) OF FUNDING

Cincinnati Children's Hospital Medical Center

GUIDELINE COMMITTEE

Not stated

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Group/Team Members: Mark Mitsnefes, MD, Nephrology; Holly Ippisch, MD, Preventive Cardiology; Elaine Urbina, MD, Preventive Cardiology; Debbie Parrott, RNII, Nephrology/Urology Outpatient Center

Clinical Effectiveness Support: Kimberly Mason, RN, MSN, PCNS-BC, Evidence Facilitator; Danette Stanko-Lopp, MA, MPH, Epidemiologist; Barbarie Hill, MLS, Pratt Library; Marta Clark, MHA, PhD, Asst VP, Business Unit Performance Improvement; Elizabeth Ricksecker, MA, EPIC Outcomes Manager

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Elaine Urbina MD is a member of the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents.

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available from the [Cincinnati Children's Hospital Medical Center](#).

Print copies: For information regarding the full-text guideline, print copies, or evidence-based practice support services contact the Children's Hospital Medical Center Health Policy and Clinical Effectiveness Department at HPCEInfo@chmcc.org.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Judging the strength of a recommendation. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2008 Jan. 1 p.
- Grading a body of evidence to answer a clinical question. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 1 p.
- Table of evidence levels. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2008 Feb 29. 1 p.

Print copies: For information regarding the full-text guideline, print copies, or evidence-based practice support services contact the Children's Hospital Medical Center Health Policy and Clinical Effectiveness Department at HPCEInfo@chmcc.org.

PATIENT RESOURCES

None available

NGC STATUS

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